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TRANSACTIONS AND PROCEEDINGS

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INVERTEBRATA, CRYPTOGAMIA, MICROSCOPY, &c.,

INCLUDING

EMBRYOLOGY AND HISTOLOGY GENERALLY.

(Journ. R. Micr. Soc., 1902, pp. 12–15.)

II.—*On Stereomicrography.*

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(*Read November 20th*, 1901.)

The beauties of the stereoscopic vision of ordinary objects, the greater amount of detail which is brought out thereby, the greater amount of information afforded by a stereoscopic over an ordinary picture of an object, which enables the third dimension in space to be appreciated, have doubtless been noticed by other workers with the Microscope, and the desire to obtain a stereoscopic picture of a microscopic object often been felt by them; but as to how to obtain the two pictures of an object viewed from different points which are necessary to produce the true stereoscopic effect, and as to methods to obtain this end, if thought out by others, no one, so far as the author is aware, has published anything practical.

It occurred to the author that this might be attainable in a manner somewhat similar to the plan he adopted for taking stereoscopic skiagraphs by X-rays, only reversed;* he therefore devised a small piece of apparatus to adjust to his Microscope that would enable him to get the necessary two pictures at an angle to the object which should equal the angle of normal vision, with eyes the axes of which are at a distance of $2\frac{1}{2}$ in. apart and converging to a point at a focal distance of 12 in.

Inasmuch as the object-glass of the Microscope is a monocular apparatus and cannot be moved, it became necessary to move the object itself in such a way that it should give a picture on the screen of the camera, as seen by one eye, and a picture thereof taken, and then to move it in such a way as to present a picture as seen by the other eye, and a picture taken in the second position, taking care to keep the same object or point thereof in the axis of the tube in each position, and thus obtain two pictures, one of which is as seen by each eye.

If we take two points $2\frac{1}{2}$ in. apart, and join them by a line, and then draw lines from the two points to a third point which is 12 in. from the first line, and in such a position that a line drawn therefrom would bisect the first line, we should have an isosceles triangle, of which the two equal sides would represent the axes of the two eyes when converged upon a point at 12 in. focus. The same may be arrived at by drawing a circle at 12 in. radius from a point, and selecting any

* Montreal Medical Journal, March 1899.

two points in the circumference $2\frac{1}{2}$ in. apart, and joining those points by radii to the centre; the two radii will represent the axes of the two eyes, and the line between them the distance between the centres of the two pupils. And now, if a Microscope slide be so placed as to form a normal with the radius representing the axis of the left eye, a picture will be given representing the object as seen by the right eye, and then, if sloped in the opposite direction without moving the central object or part thereof, it will, when viewed in the course of the second radius, present a picture as seen by the left eye.

Now, if a Microscope slide with the objects upon it be moved on a centre or point of convergence so as to make the surface of the slide a plane normal to the line representing the axis of the left eye, it

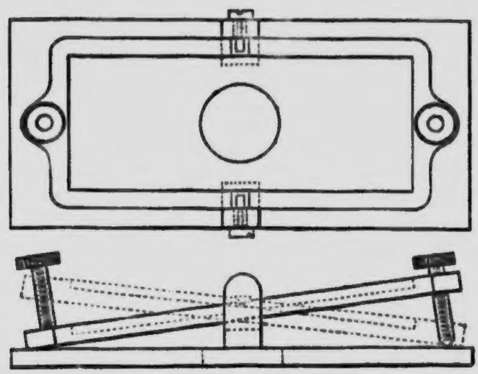

Fig. 14.

The apparatus is adjusted upon the stage of the Microscope so that the centre is in the optic axis of the instrument. The object is placed on the tilting table by spring pressure (springs not shown). The level of the object is the same as the axis upon which the tilting table swings, so that the motion of the table does not alter the position of the object except as to inclination. The object may be moved about till the required portion to be photographed is found, the tilting table being rigidly attached to the Microscope; and the inclination of the table is set by means of the two screws at its ends.

will give a picture as seen by the right eye; and shows from the right what is hidden behind the central object of the picture; and if it be inclined so as to form a normal with the line representing the axis of the right eye, the picture seen in the Microscope will be the picture as seen by the left eye, and shows objects behind the central object as seen from the left side. If two pictures be taken thus, and these two pictures printed and mounted, they will give most beautifully the stereoscopic effect, and will show at once in the stereoscope the third dimension and the different planes in which the objects are seen at the time of observation.

The plan adopted by the author to obtain these results was to have a rocking stage made in such a way that an ordinary glass slide with its object shall be held securely and focussed; and as soon as the particular part of the specimen to be photographed is placed exactly in the centre of the field, and the nearest part of the object focussed sharp, or in such a manner as to give the best picture of the object, then the rocking stage is rocked by means of the screws for that purpose till the one side is depressed (say the right side of the slide) to an angle of 7½ degrees to the plane of the Microscope stage, and a picture taken. Then, after seeing that the focus is unimpaired by the movement, and that the object has not moved from its central position, the slide is made to rotate about the point of convergence till it is rocked to the extent of 7½ degrees inclination to the proper stage of Microscope on the opposite side. Then, on seeing that the focus is correct and the object still in the centre, the picture as seen by the right eye is represented, and a picture is taken. The negatives so obtained are printed, and the prints mounted give the proper stereoscopic effect. The accompanying mount, which is a photograph of uric acid crystals, shows the result. The results so obtained, when seen by any one, will be admitted to give a better idea of the object than a single picture.

The rocking slide used by the author consists of a flat stage with a central opening which attaches to the ordinary Microscope stage by springs. From the upper surface of this project two lugs, one in front and one in rear, and from these lugs project inwards towards each other two knife-edges, the edges placed downwards towards the Microscope stage; under these knife-edges, and pressed up against them and rocking on them, is a flat plate of brass cut out flat to receive a glass slide so as to allow of the movement of the object, and cut out of such a depth that the surface of the glass and the knife-edges are in the same plane. This plate of brass is extended far enough on either side to be drilled at equal distances from the centre and tapped for a screw; a thumb-screw is placed in each; and as one screw is turned in the other is turned out, till the slide is either parallel with the Microscope stage proper, or at [illegible] required angle to it.

A little angle of brass being screwed on to the bed-plate of the stage and projecting up in front of one end of the rocking stage, and marked with a zero point at which the rocking stage will be parallel with the bed-plate, and then with [illegible] degrees marked above and below the zero point, the inclination of the slide in the two positions can be made exact; and 7½° angle [illegible] stage-base is enough to place the slide in the position of a n[illegible] the axis of vision. The author avails himself of this opportunity of recording his thanks to Messrs. R. and J. Beck, of Cornhill, London, for the kind attention they gave him in making the piece of apparatus by which these results have been attained.

The author gives this account of his success, that others may be

able to extend the work, apply this method to other objects, and produce pictures of microscopic objects in relief, and thus give to students a more realistic idea of the objects before them.

The method adopted in taking the pictures exhibited with this paper was to place an ordinary photographic camera horizontally on the table, raised so that the opening for the lens should be just centred with axis of the Microscope tube; when the Microscope was turned on its stand to the horizontal position, a thin sheet of vulcanised india-rubber was secured over the hole for the lens in front of the camera, a small hole was cut in the centre of the rubber-sheet, and the Microscope tube without an eye-piece was thrust through the small hole in the rubber, which fits tight round the tube and stops all light entering; a small diaphragm was placed in the end of the tube to stop light reflected from the inside of the tube, and the object was illuminated by a coal-oil lamp placed opposite the opening in the stage and condensed by a bull's-eye focussed in the usual way. If necessary a micrometer might be used on the stage to show magnification.

In the case of the crystals of uric acid shown, a 1-in. object-glass was used, 30 seconds exposure with a small single coal-oil lamp, and the picture was developed with Rodinal developer in the ordinary manner. In the case of starch-granules of ginger grown and prepared by the author himself, a $\frac{1}{6}$-in. object-glass was used with polariscope; exposure for each picture half an hour.

Since perfecting the apparatus for this work, the author has had brought to his notice the original article by Sir Charles Wheatstone, 'Contributions to the Physiology of Vision, Part the First, On some remarkable and hitherto unobserved Phenomena of Binocular Vision,' *Philosophical Transactions*, 1838, reprinted in 1879, wherein the correctness of the ideas the author had in designing this stage are completely borne out.

When a picture is taken by a Microscope, the picture of the object is reversed, and when this negative is printed it is reversed again, so that the print corresponds to the object itself as seen in the Microscope; but in transparent objects, reversal of the prints in mounting would give a stereoscopic view of the object as seen from the other side, which in some cases may be desirable.

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